INCREASING SUCCESS AND INFORMATION SEARCH

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13. ABSTRACT

Predictions from four theories or extensions of theories for information search under conditions of increasing experimentally induced success were compared. Subjects participated in an experimental simulation. The number of search decisions and the ~~r~~ ~~ilization~~ of information gained through search were measured. It was found that increasing experimentally induced success produces diverse information search effects. Information search increases for homogeneous groups of complex (multidimensional personality structure) and decreases for groups of simple (more unidimensional personality structure) subjects. Earlier statements of complexity theory were unable to predict the results. Revised complexity theory (Streufert, 1970) did predict the obtained data. The behavior of complex groups was predicted by the position of Lanzetta and associates. The behavior of simple groups matched the predictions of extensions of learning theory and the information search theory of Feather. The potential basis of the results is discussed.

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INCREASING SUCCESS AND INFORMATION SEARCH[1]

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Psychological approaches to human behavior have often viewed the human organism as an "information processing system." An individual is described as a processor who seeks, receives and processes information input into some form of measurable output. What kind of search, what kind of processing, and what kind of output is of interest to a researcher tends to depend on his theoretical orientation. All the diverse views, however, consider information as the basis of their formulations.

The underlying interest in information search is certainly not a new one. Experimental psychologists concerned with signal detection have published volumes of papers on the subject. Research on information search effects on concept formation has been extensive. Social and personality psychologists, however, have used information processing approaches in the sense of "experimental psychology" only in the last two decades. Lanzetta and associates (e.g., Driscoll and Lanzetta, 1965; Driscoll, Lanzetta, and McMichael, 1967; Hawkins and Lanzetta, 1965; Sieber and Lanzetta, 1964; 1966), for example, have studied information search via the information theoretical "uncertainty" concept. They found that uncertainty produces search or preference for information until only low (1 bit) levels of uncertainty remain. They also found that higher levels of uncertainty produce faster or more search, and that importance suppresses or has curvilinear relationships to search.

Other researchers have related search to consistency models (e.g., Festinger, 1964; Rhine, 1967). Here search is viewed as a consequence of certainty in the searching individual who believes that he can successfully deal with potentially dissonance arousing information. Other theorists have expressed the opposite view (e.g., Berlyne, 1966; Maddi, 1961; Driver and Streufert, 1965; Streufert and Driver, 1970). These "motivational complexity" views propose that search activity is motivated independently from a tension reduction principle.

Brock (1969) has proposed an economically based "commodity theory" suggesting that persons will engage in search for information when it is rare, unavailable, or otherwise difficult to obtain. Feather (1967) predicts information search from a model employing motives, expectancy and incentive. Finally, the complexity theory of Driver and Streufert (1966), Schroder, Driver and Streufert (1967) and Streufert and Driver (1967) predicts information search from the information quantity already available in the environment and from the personality structure of the potentially searching individual. The latter two theoretical formulations (Feather's theory and complexity theory) fulfill the requirements of Cronbach (1957), Eysenck (1966), Feather (1962) and MacKinnon (1944) who have pointed toward the need of viewing information search from both environmental and personality aspects.

The differential predictions of the various search theories often apply to conditions which are not clearly comparable, making decisive testing of one theory against another difficult. However,

Streufert and Castore (1971) were able to test a number of theories (or extensions of these theories) in a single experiment: (1) complexity theory, and the theories of (2) Lanzetta (3) Feather, and (4) Brock. Predictions were based on the effects of failure on information search. The data produced limited support for complexity theory and did support, where applicable, the theories of Lanzetta and Feather. Brock's commodity theory was not supported. It should be noted that these results were obtained under failure manipulations and that the generality of the findings can only be assured when similar data are obtained through the use of other manipulations as well. The research reported in this paper extends that work to effects of success.[2] Predictions of several theories or their extensions are presented below:

1. Complexity Theory

Complexity theories are concerned with the personality structure of human information processing (see the Handbook chapter by Zajonc, 1968 and the review of personality structure of Wiggins, 1968). An extensive theory relating environmental and personality structure predictions was presented by Driver and Streufert (1966), Schroder et al. (1967), Streufert and Driver (1967) and Streufert and Fromkin (1972). The theory has produced a good amount of research on the effects of information search (e.g., Karlins, 1967; Karlins, Coffman, Lamm and Schroder, 1967; Karlins and Lamm, 1967; Sieber and Lanzetta, 1966; Stager, 1967; Streufert and Castore, 1971; Streufert, Suedfeld and Driver, 1965; Streufert, S. C., in press; Suedfeld and Hagen, 1966; Suedfeld and Streufert, 1966; Tuckman, 1964). Generally it has been

found that (a) persons of complex[3] conceptual structure (i.e., multidimensional information processors) seek more information when it is useful to integrate that information, (b) that persons of simple structure (more unidimensional information processors) seek information when insufficient information is present to respond to a specific requirement or query from the environment, and (3) that increasing relevant information load results in decreasing information by all subjects, but (4) that this decrease is more pronounced for persons of simple structure (for a detailed review of complexity theories and research, see S. C. Streufert, 1972).

In its early form (Driver and Streufert, 1966; Schroder et al., 1967), complexity theory viewed failure and success (together with information load) as two of the three summative and similar components of environmental complexity. That view suggested that search should decrease with increases in failure or success proportions of information presented to subjects. Revisions of that theory (Streufert, 1970) transformed failure and success predictions into load predictions, suggesting that failure information produces increasing relevant information load (since decisions resulting in failure need to be made over again), and that success information should be equivalent to decreasing load (since success in an operation negates the necessity to continue activity). While earlier forms of complexity theory predict greater levels of information search for subjects (or homogeneous groups of subjects) with complex conceptual structure, the revised theory predicts that simple subjects (or groups) should respond to the most salient mode of the environment, e.g., to reinforcement conditions, while complex subjects should respond to the

strategic (multidimensional) demands (components) of their environment. In other words, early complexity theory formulations would suggest that (1) increasing success (positive reinforcement of decisions made by a group of structurally homogeneous subjects) should result in decreasing information search. The decrease should be greater for simple than for complex subjects. Revised complexity theory formulations (Streufert, 1970) would suggest that groups of simple subjects should increase information search with increasing success (reinforcement salience, since decisions based on previous information search lead to success), while groups of complex subjects should decrease information search activity (since there is little strategic necessity for search when the group has been successful in its task).

2. Reinforcement Theory

Learning theory formulations do not specifically discuss manipulations where reinforcement contingencies increase from low to high levels of partial reinforcement (the increasing success manipulation employed in this experiment, see below and the parallel research of Streufert and Castore with failure effects). Nonetheless, predictions can be derived from the standard formulations. If the unconditioned search response is reinforced by success, one should reasonably predict that search would increase as success (positive reinforcement) increases. The exact function of the relationship between the reinforcement schedule and the conditioning of information search remains in question. Nonetheless, the prediction would be the same as one made for simple subjects in revised complexity theory formulations: increasing success should result in increasing search.

Uncertainty Formulations

Lanzetta and associates relate information search to uncertainty and information importance (see above): the greater the uncertainty and the less extreme the importance, the greater search should be. If we can assume (as did Streufert and Castore, 1971) that decreased "uncertainty" in Lanzetta's sense implies greater knowledge of the probable outcome of the task into which subjects are placed (cf. Streufert and Streufert, 1969), then this uncertainty should decrease with increasing success. (Ratings of a probable success on a seven-point scale obtained from subjects exposed to increasing success show that subjects predict significantly greater success for their team as success increases.) In other words, Lanzetta's views would suggest that information search should decrease with increases in success.

The second of Lanzetta's predictions is concerned with value: as value of the information increases, search should decrease. Ratings of information value on a seven-point scale did not vary with increasing success, so that the predictions made via Lanzetta's formulations should be entirely based on certainty.

Feather's Theory

A segment of the theory of Feather (1966) is directly applicable to success manipulations. Feather predicts that the tendency to chose information X is a function of $T_{\tau,g} + T_{x,p}$ where $T_{x,g}$ is the positive tendency to select X because it may lead to rewards or goals and where $T_{x,p}$ is the negative tendency not to select X because it may lead to threats or punishments.

In the present research methodology, the necessary goal oriented behavior (cf. Feather, 1966) can be assumed (Fromkin and Streufert, in press; Schroder et al., 1967). Information search activity under increasing success should consequently be primarily affected by $T_{x,g}$, since rewards are increasing (and the subjects see their goals more and more realized), while punishments are entirely absent. Feather's theory then should predict increasing information search behavior.

METHOD

Subjects

Five hundred and seventy-six paid male volunteers were tested with the Sentence Completion Test (Schroder and Streufert, 1963; Schroder et al., 1967) as a measure of conceptual structure. The tests were scored on a seven-point scale. Scores 1 and 2 represent simple structure: no differentiation, no integration. Scores 3 and 4 represent levels of differentiation, but no integration. Scores 5 and 6 represent complex structure with differentiation and integration, and score 7 represents highly complex structure with differentiation and high levels of integration. Inter-rater reliability on scoring the test was r = +.92. Split half reliability was r = .83. Total test scores were based on the results from the two most complex (differentiated or integrated) responses obtained from each subject.

Twenty-four subjects of simple (more unidimensional) conceptual structure (score 1, no differentiation, no integration) and twenty-four subjects of complex (more multidimensional) conceptual structure (scores 5 through 7, capacity to differentiate and integrate) participated in the experiment. An additional twenty-four subjects, unselected for complexity, were assigned to a control condition.

Structurally homogeneous two-man groups (dyads) were formed. Subjects participated in the Tactical and Negotiations Game (TNG), an experimental simulation for a period of ten consecutive hours. (For a discussion of the controlled experimental simulation research technique, see the handbook chapter of Fromkin and Streufert on laboratory experimentation, in press.) Subjects were paid one dollar for each hour, and were promised an extra four dollars if they would "win" the game. However, the progress and outcome of the game (unknown to the subjects) was predetermined (see below).

The Environment

Each of the thirty-six dyad decision-making teams was given the task of directing the military, economic, intelligence, and negotiation activities of a small underdeveloped nation called "Shamba" which was plagued by an internal revolution.[5] Subjects read a manual on historical, economic, and military information about this nation. The time required for reading the manual was approximately two hours.[6] After reading the manual, subjects were told that they would be permitted to make decisions of military, economic, intelligence and negotiation characteristics within the limits of their resources. Decisions were made on forms provided for this purpose and sent to the experimenters. Subjects were informed that they were playing the Tactical and Negotiation Game against another team, and that the game would continue for a number of periods of indeterminate length until the issues of the "Shamba conflict" were resolved. The experimenters would serve as judges, assisted by a computer, and information on the outcome of subjects' decisions would be fed back to them as soon as available.

In fact, subjects were playing against a pre-determined program. Subjects received seven pre-typed messages (all teams received all messages in different random order) equally spaced during each of seven

one-half hour periods. Intermissions between the periods were used to have subjects fill out additional forms (rating scales). Subjects were not told which period would be their last.

Of the seven programmed messages received by the subjects during each one-half hour period, two reported on military, two on economic, two on negotiation and one on intelligence "results." The order of the reporting areas was varied at random. During the first period of play one message (selected at random) reported success. All other messages were neutral in content. During the second period, two messages reported success, and so forth, until in the last (seventh) period, all messages reported success. In other words, success was steadily increased across periods from level 1/7 to level 7/7.[7] In line with the results previously reported by Higbee and Streufert (1968), success perception (obtained on a rating scale in the intermission after each playing period) increased in linear fashion with induced success levels. Dyad teams assigned to the control condition received no success messages. Their responses on the manipulation check for perceived success produced no significance.

The design of the experimental simulation (cf. Streufert, Kliger, Castore and Driver, 1967; Streufert, Castore, and Kliger, 1967) and the characteristics of the program (informative messages) assures that subjects received information that sufficiently answered the majority of their information search decisions. Subjects' responses to a scale concerned with the quality of information feedback in response to search decisions indicated that they perceived information quality to be consistently moderately high.

Subjects' estimates of attribution of causality (cf. Streufert and

Streufert, 1969) were obtained during each intermission. For this purpose subjects were asked to indicate the percentage of their current situation that was caused by (1) their own decisions, (2) decisions of the opposing team, (3) chance factors, (4) arbitrary decisions of the experimenters, and (5) characteristics of the environment. The total had to sum to 100 per cent. It was found that combined causality attributions to the last three components did not rise above 20 per cent. These results were viewed as face validity of the experimental manipulation (cf. Streufert and Streufert, 1969).

The selection of seven (rather than a smaller or larger number) informative messages per one-half hour was determined by previous results reported by Streufert and Driver (1965; 1967) and Streufert and Schroder (1965) and S. C. Streufert (in press). This research has demonstrated that optimal information processing (maximally strategic and/or multidimensional behavior) occurs at approximately ten items of relevant information per one-half hour. Selection of an information point somewhat below this optimal assures that no artificial limitation is placed on group responses if the additive predictions of early complexity theory should be borne out.

Data Collection

(1) Information search. The information search measure was based on the decisions which groups of subjects made during each of the playing periods. Subjects marked each decision with one or more decision type categories, e.g., economic investment, military attack, information search, and so forth. The number of decisions in any one period which

subjects considered "information search decisions" was counted.

(2) Information utilization frequency. Here we were concerned with the utilization of information supposedly gained through self-initiated search. A score of 1 was assigned to each future decision which was based on information received by subjects relevant to any previous information search decision (cf. Streufert, Suedfeld and Driver, 1965; Streufert and Castore, 1971). The total score for any playing period was the number of future decisions which were consequentially related to information search decisions made by a team during that particular period.

RESULTS AND DISCUSSION

Information Search

The data were analyzed with a two-way mixed design ANOVA technique. The factors were (a) complexity (two levels, between) and (b) periods of increasing success (seven levels, within). No significance was obtained for the complexity main effect ($F = 3.92$; 1/22 df; N.S.). The main effect for increasing success ($F = 2.70$, 6/132 df) was significant ($p < .05$). Significance was also obtained for the complexity by increasing success levels interaction ($F = 16.49$; 6/132 df; $p < .01$). The data are graphically presented in Figure 1.

Post hoc Newman Keuls analysis based on the interaction error term indicated that increasing success induction resulted in increasing information search activity for groups of simple (more unidimensional structure) subjects. Periods 1 and 2 were significantly different from periods 5, 6 and 7 ($p < .01$). Lesser significant differences ($p < .05$) were obtained for some of the more adjacent points. Newman Keuls analysis further indicated that increasing success induction resulted in decreasing search activity for groups of more complex (multidimensional structure) subjects.

Since the F ratio calculated for the simple main effect based on groups of complex subjects over increases in success (F = 2.44; 6/66 df) was only significant beyond the .05 level, Newman Keuls comparisons producing higher levels of significance will be considered as significant at the .05 level only. Significance was obtained for comparisons of periods 1 and 2 with periods 6 and 7.

A separate analysis for the control groups (subjects unselected for complexity, no success) produced no significance (F < 1.0). The possibility that the information search results might have been due to time effects is consequently eliminated.

How do these data relate to the various information search theories discussed earlier? The initial complexity theory proposed by Driver and Streufert (1966), Schroder et al. (1967), and Streufert and Driver (1967) cannot account for the data. Decreasing information search should have occurred for both groups of simple and groups of complex subjects, and information search activity for complex subjects should have exceeded that of simple subjects. Neither is the case. Revised complexity theory (Streufert, 1970) fits the obtained data considerably better. Simple subjects apparently responded to reinforcement salience without regard to the fact that their task did not require further search once high levels of success had been obtained. Much of the search for these groups was of the "vigilance" type: since in previous playing periods vigilance had apparently helped prevent potential problems (as success was often interpreted), these groups maintained that stance. Complex subjects on the other hand engaged in more search when success levels were low (comparisons of first period search between groups of complex

and simple subjects was significant beyond the .05 level) and when information was valuable for the development of strategy. Again, in contrast to groups of simple subjects, groups of complex subjects decreased search as it became less and less needed to form strategies (and their efforts were apparently crowned with more and more success) [$p < .01$ for the last period comparisons between simple and complex groups].

Reinforcement theory did predict the behavior for groups of simple subjects accurately but did not predict behavior for groups of complex subjects. Since the majority of persons in most subject samples tend to consist of simple subjects, the finding that reinforcement predicts their behavior more than that of those who are complex is not surprising.

The uncertainty based view of Lanzetta correctly predicted the behavior for groups of complex subjects, but not for simple subjects. His data have been primarily collected at eastern universities, where the incidence of complex subjects in student populations tends to be somewhat higher than, for example, in the midwest. Another reason for this result may be found in the tasks often employed by Lanzetta and associates. For example, a subject may be exposed to a tachistoscopially presented slide containing an unclear image. The subject is to make a decision about the content of the slide as uncertainty is decreased together with the pay-off for correct identification. Such a task is potentially multidimensional in nature, although much less so than the TNG task which was used in the present research. One may assume that subjects of intermediate complexity could respond to Lanzetta's task requirement in a somewhat more complex fashion than they could in the TNG, increasing the number of subjects who would operate as "complex" decision

makers. If this is so, then Lanzetta's predictions may describe a more complex behavior pattern.

Feather's (1966) views are supported by the behavior of simple subjects. Using a goal oriented prediction is not unlike the reinforcement prediction discussed earlier. It appears that simple subjects are more dependent on the $T_{x,g}$ formulation than complex subjects are, likely again because of the salience characteristics of the success (in Feather's terms reward) contingencies.

Information Utilization Frequency

The predictions of early forms of complexity theory (discussed above) can also be compared with revised forms of that theory via measures of information utilization. Previous research varying information load (Streufert et al., 1965) and failure (Streufert and Castore, 1971) have shown that groups of complex subjects score higher in integrative information utilization than groups of simple subjects. Further, early theory would predict that success induction should have the same results as load and failure induction: an initial increase and later decrease of integrative information utilization with increasing success levels (since the load level of 7 items of information per half-hour is "suboptimal)." Revised complexity theory would predict such a curvilinear effect for load and for failure (since failure is reinterpreted as increasing load) but not for success. Success, implying decreases in load conditions in the later complexity formulation, should result in moderately low and relatively constant search activity with only small, if any differences between groups consisting of complex and simple subjects.

The data on integrative information utilization were analyzed with a mixed design ANOVA, identical to the one utilized in the previous analysis. The complexity main effect ($F = 2.86$; 1/22 df) and the main effect for increasing success levels ($F = 1.02$; 6/132 df) were not significant. The interaction effect ($F < 1.0$) was also insignificant. Information utilization appeared slightly higher for groups of complex subjects in early playing periods, but differences were too small to produce significance. These results tend to support revised complexity theory rather than earlier propositions, particularly if one considers that earlier load (e.g., Streufert et al., 1965) and failure (e.g., Streufert and Castore, 1971) manipulations resulted in rather strong complexity differences.

Conclusions

This research has compared several theoretical predictions or derivations which have relevance to information search. The data indicate that increasing experimentally induced success produces diverse information search effects: information search increases for groups of complex (multidimensional structure) subjects and decreases for groups of simple (unidimensional structure) subjects. The behavior of complex groups is predicted by revised complexity theory and by the propositions of Lanzetta and associates. The information search behavior for groups of simple subjects is predicted again by revised complexity theory and by extensions of Feather's views and learning theory. Earlier versions of complexity theory did not predict either of the measured behaviors.

The results obtained in this research and the earlier research on load and failure effects on information search suggest that inconsistencies in information search data might be due to the operation of moderator variables. One of these would be the complexity of subjects participating in the experiments. Another could be the degree to which a task permits subjects to utilize their complexity level. It might well be that multidimensional tasks which cannot be solved along all dimensions without the presence of structural (personality) multidimensionality in information processing will produce different search characteristics than simpler tasks which do not require the same information processing characteristics. For example, the tasks employed by Lanzetta and associates which are potentially more limited in dimensionality may allow for more "complex responding" by subjects who are less multidimensional information processors.

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Footnotes

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[2]Use of failure (negative reinforcement) and success (positive reinforcement) manipulations are especially useful for testing the predictive usefulness of learning theory derivations simultaneously with other theories.

[3]It has been repeatedly established that relationships between intelligence and complexity are very low or non-existent. The same holds for data collected in the present experiment.

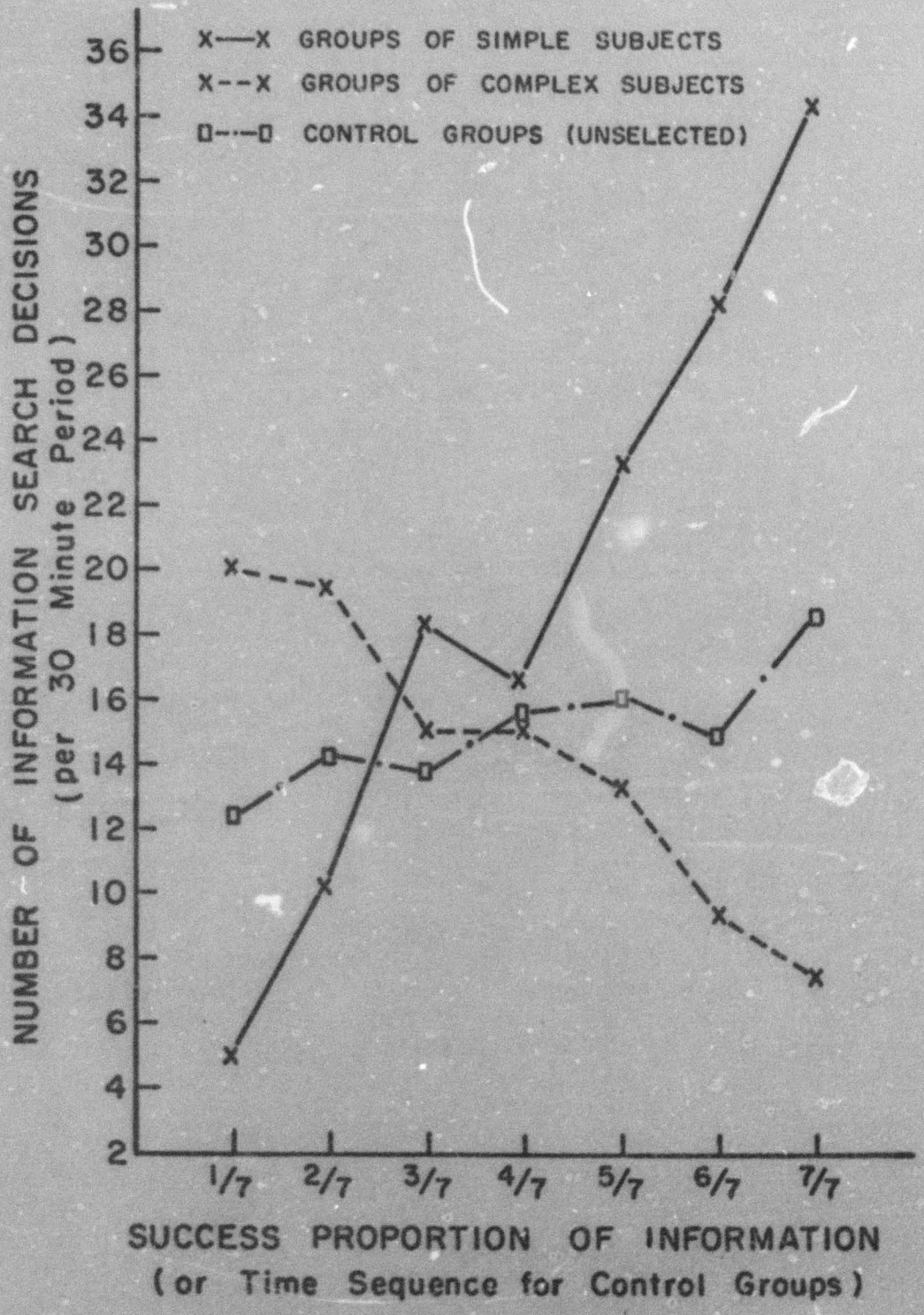
[4]Although Feather considers choice X, when Y, Z, etc., are available as alternate choices, we will modify his choice constellation to mean: X means choosing to search for information, and the alternative Y means not to search for information (cf. Streufert and Castore, 1971).

[5]Detailed descriptions of the game are presented by Streufert, Kliger, Castore and Driver (1967), and Streufert, Castore, and Kliger (1967). The game is a complex experimental simulation permitting experimenter controls (programming for fixed sequence) of the subjects' environment throughout their participation in the game.

[6]In addition to its value as an instrument of information, presenting facts about "Shamba" to the subjects on a number of dimensions, the manual was useful to equalize the experience of subjects before beginning experimental participation. Some of the variability due to immediate pre-experimental experiences of subjects was thereby reduced.

Footnotes (cont'd)

[7]On first thought, randomization of success levels might be conceived as an attractive alternative to sequential increase of failure levels. However, as previous research has shown, any decrease in success is perceived by subjects as failure. Linearly increasing success perception as a function of increasing success levels can be reliably obtained only when sequential success induction is employed (cf. Higbee and Streufert, 1968).


X—X GROUPS OF SIMPLE SUBJECTS
X--X GROUPS OF COMPLEX SUBJECTS
□-·-□ CONTROL GROUPS (UNSELECTED)
NUMBER OF INFORMATION SEARCH DECISIONS (per 30 Minute Period)
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
1/7
2/7
3/7
4/7
5/7
6/7
7/7
SUCCESS PROPORTION OF INFORMATION
(or Time Sequence for Control Groups)